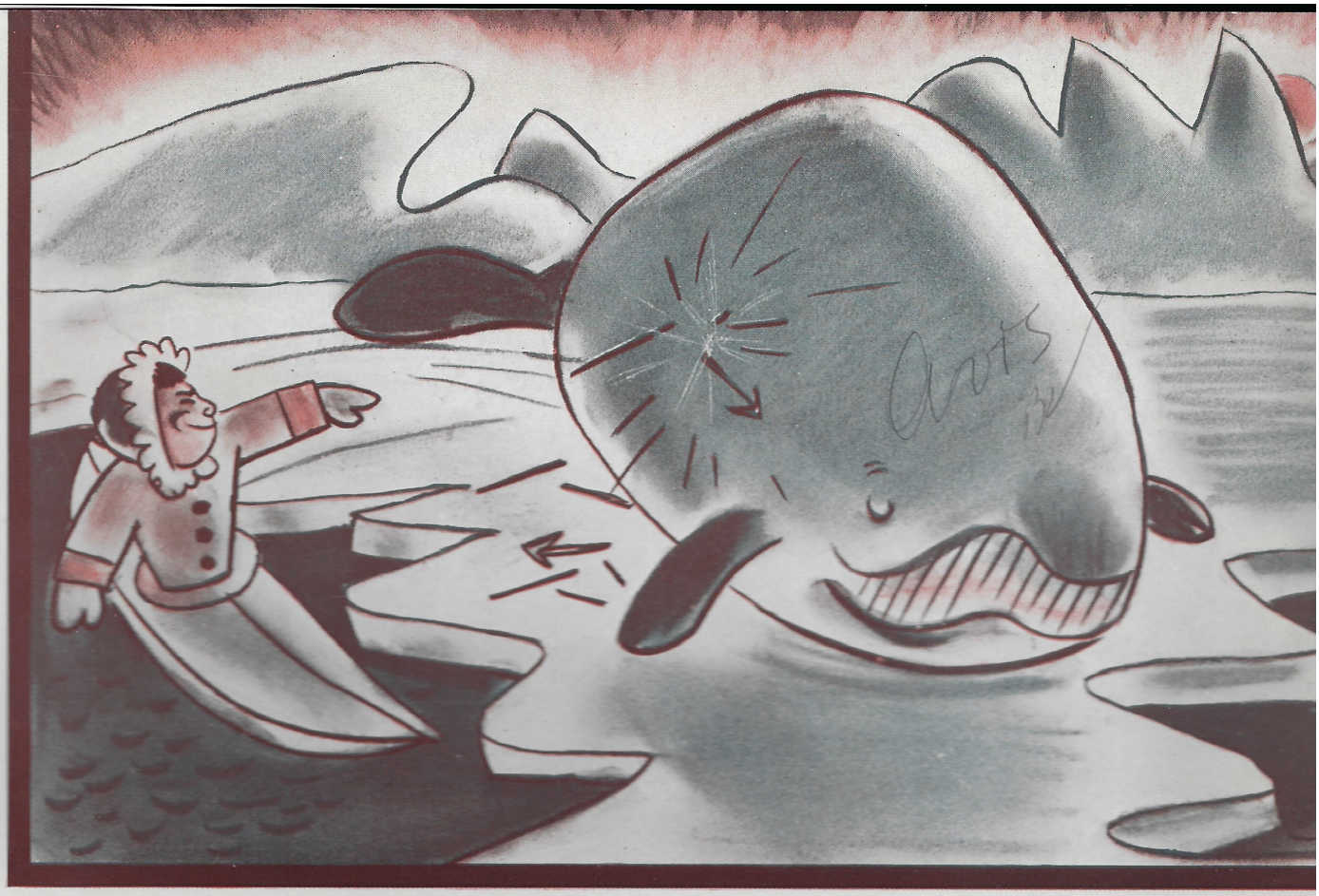
WHAT ABOUT LOW AND



HIGH TEMPERATURES *AND* METALS?

No. 3 *in a series of informative folders from*
EAGLE METALS COMPANY

HOT NEWS

● Long before Nero discovered that heat was helpful, industry depended upon high temperatures for the completion of certain manufacturing processes in the glass and ceramic industries, in refining metals.

Today, the tendency in mechanical and chemical engineering is toward ever higher temperatures, for they mean more efficient operation of steam equipment, and in manufacturing chemistry, make possible high temperature reactions and speed up production.

In all kinds of combustion engines, in domestic heating, and in hundreds of other industries, there is a growing need for metals which can withstand the effect of superheated steam, hot gases, and molten materials.

—AND COLD FACTS

● Conversely, while not so important in the past as high temperatures, cold climates have required materials which could function well when the mercury fell 'way out of sight.

Lately, the refinements of our modern civilization make great demands for low temperatures in refrigeration, the quick freezing of food products, for dewaxing oils, and in liquifying and solidifying gases. In the latter instance, temperatures lower than 400° F. below zero are reached—very close to absolute zero—temperatures at which rubber, and lead, materials so flexible at room temperature, become as brittle as egg shells.

It's all very well to have strawberries in January, and a spot of seltzer now and then, but it took metals capable of withstanding extremely low temperatures to make them possible.

METALS VS. HIGH AND LOW TEMPERATURES

● Metals behave like elastic materials at atmospheric temperatures, but at elevated temperatures they have the properties of a plastic material, while at low temperatures, they tend to become brittle. In either case, toughness, the combination of strength and ductility is of the greatest importance. Monel, Nickel, and Inconel enjoy the distinction of being among the very few metals which retain a high percentage of their strength and toughness at elevated temperatures, and retain *all* their room temperature toughness and *increase* in strength at low temperatures. To convince the skeptical, we present the figures herewith:

METAL	STRENGTH AT HIGH TEMPERATURES (Pounds per square inch Tensile Strength)			STRENGTH AT LOW TEMPERATURES (Pounds per square inch Tensile Strength)			TOUGHNESS (Foot pounds Charpy Impact)		
	Room	800°F	1000°F	Room	−112°F	−310°F	Room	−112°F	−310°F
Copper (Cold Rolled)	45,800	11,500	7,500	45,800	——	53,000	43	44	50
Copper (Annealed)	——	——	——	32,800	37,400	——	—	—	—
70-30 Brass (Cold Rolled)	57,100	20,000	7,500	57,100	——	81,100	65	69	78
70-30 Brass (Annealed)	——	——	——	41,500	48,600	——	—	—	—
Aluminum 25 (Cold Rolled)	24,000	1,100	——	24,000	——	33,000	19	20	27
Low Carbon Steel (Annealed)	55,000	47,200	30,500	55,000	71,000	103,000	33	4	0
Monel (Hot Rolled)	85,000	69,800	49,800	——	——	——	—	—	—
Monel (Annealed)	——	——	——	70,700	85,400	112,000	215	219	207
Nickel (Annealed)	65,600	59,000	45,000	65,600	76,500	98,000	216	236	234
Inconel (Hot Rolled)	89,500	84,200	81,500	——	——	——	236	206	187

NORTHWEST *Headquarters for*

NON-FERROUS METALS

We are distributors for the widest variety of non-ferrous metals in the Pacific Northwest. Immediate deliveries from warehouse stocks —or direct mill shipments, as you prefer.

MONEL	COPPER	ALUMINUM
NICKEL	BRASS	DURALUMIN
NICKEL-CLAD STEEL	NICKEL SILVER	COMMERCIAL BRONZE
INCONEL	"K" MONEL	PHOSPHOR BRONZE

Sheets — Rods — Tubing — Pipe — Wire Cloth — Wire

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Technical Information Without Cost

We invite you to call upon us for technical information concerning any problem in the use of non-ferrous metals. We place at your disposal the technical staffs and research laboratories of The International Nickel Company, Inc. (alone in its field), The Aluminum Company of America (alone in *its* field) and Revere Copper and Brass, Inc. (finest research laboratories in the industry) . . . in addition to our own facilities. No obligation, of course.

EAGLE METALS COMPANY

MAIN 8375

3628 East Marginal Way **Seattle, Wash.**

THERMAL EXPANSION AND CONTRACTION

● Metals expand when heated, and contract with cooling, occasionally a most troublesome habit. Roofing sheets, for example, should have a low coefficient of thermal expansion. The 151,000 square feet of roofing on the New York Public Library presented a considerable problem in this respect. The fact that Monel's coefficient of expansion is low, minimizing the breaking open of soldered seams and buckling caused by temperature changes, is one of the reasons why it was chosen for this roof.

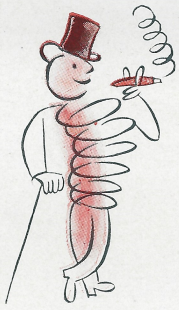
Here's how 1000 feet of the following metals increase in length as the temperature rises from 0° F. to 100° F.:

Metal	*Inches*
Copper	11.3
Zinc	22.9
Aluminum	14.6
Lead	19.4
Steel	8.7
Monel	9.3
Nickel	8.7
Inconel	7.7

You will notice that Monel, Nickel and Inconel are very close to steel in this respect, making possible combinations of steel with these metals for heat exchangers, condenser tubes, accessory items, clad materials and other applications without producing complications resulting from differences in expansion properties.

SPRING PROPERTIES AT HIGH TEMPERATURES

● It has always been a problem to get springs to function satisfactorily under high temperature conditions. The fact that Monel, Nickel and Inconel retain their elastic strength at elevated temperatures make them valuable for this purpose, as this table indicates.



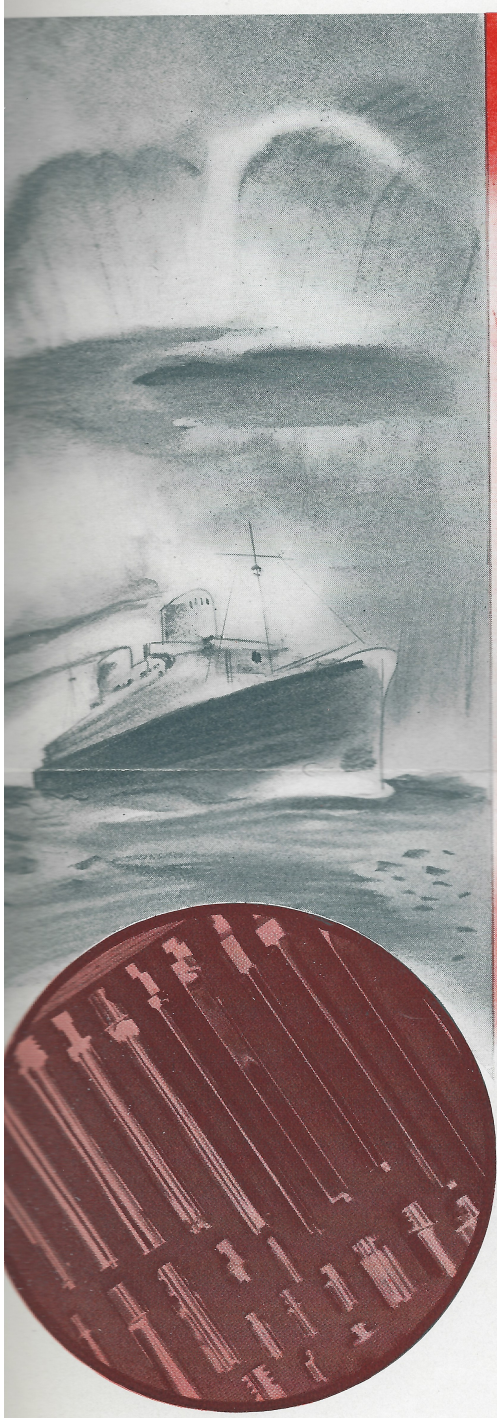
METAL	*Max. Operating Temperature Degrees Fahrenheit*
Ferrous	
Music Wire	200
Carbon Steel	400-430
Chrome Vanadium Steel	400-430
Tungsten Steel (high alloy)	700
Non-Ferrous	
Inconel	650
Nickel	400
Monel	500
Phosphor Bronze	Atmospheric
Brass	Atmospheric

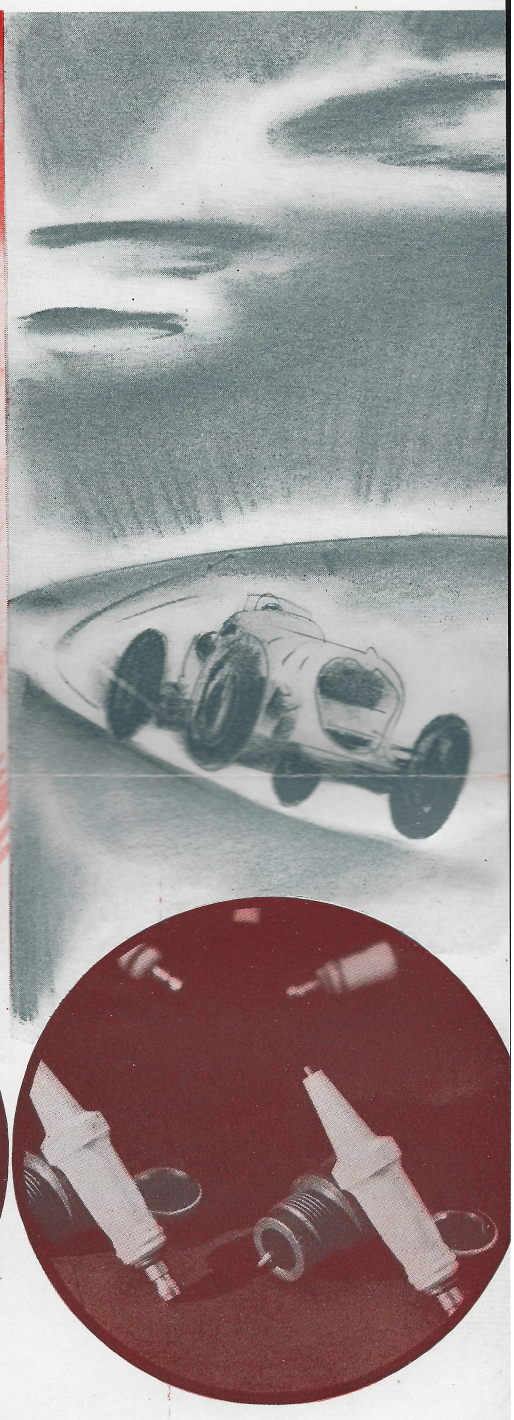
BOILED DOWN

● Boiling everything down, we find that Monel, Nickel, and Inconel are extremely valuable metals, in that they may be safely used at high and low temperatures without greatly affecting their excellent properties of high strength, toughness, resistance to wear, and erosion.

Combined with these properties are the attractive appearance of these metals, their exceptional resistance to corrosion, freedom from rusting, and ease of forming. In fact, sometimes we modestly admit that they have "just about everything."

Against High Heat on Land and Sea . . . In the Air





The Bremen—pride of the North German Lloyd transatlantic fleet—is driven from its home port to New York and back by its Monel turbine blading (shown in the insert). Monel resists the corrosive and erosive effects of steam and is strong enough and tough enough to drive the giant liner at high speed through the heaviest seas. Monel turbine blading has driven many types of boats for years —from luxurious liners to workaday tugs and ferry boats.

The original China Clipper and the six new Pan American Clipper ships now in construction use Inconel exhaust manifolds to resist the destructive effect of repeated heating to 1200° F.-1400° F., and cooling, aggravated by motor vibration. Large transport ships equipped with Inconel manifolds must sometimes be brought down on a snowy field or in sleet, and a metal which can withstand cooling from red heat to zero so suddenly without cracking or loss of ductility really has something.

Explosions, hundreds of millions of them, drive our fast cars and all sorts of combustion engines today. And while speed was being stepped up, so was spark plug quality by the use of manganese nickel electrodes. The electrodes (the part partially covered by porcelain in the small photo above) must not only be able to conduct a current well, but resist the high heat and corrosion of the combustion gases and the detrimental effect of the passage of numberless sparks.

AVAILABLE PRODUCTS & FORMS
OF
MONEL, NICKEL AND INCONEL

STANDARD SHEET
Monel, Nickel and Inconel

*

FULL COLD ROLLED SHEET
Monel, Nickel and Inconel

*

HOT ROLLED PLATE
Monel, Nickel and Inconel

*

COLD ROLLED STRIP
Monel, Nickel and Inconel

*

NICKEL-CLAD STEEL PLATE

*

INCONEL-CLAD STEEL PLATE

*

FORGINGS
Monel, Nickel and Inconel

*

HOT ROLLED ROUNDS, FLATS, HEXAGONS, SQUARES, ANGLES *and* SPECIAL SHAPES
Monel, Nickel and Inconel

*

COLD DRAWN ROUNDS, FLATS, HEXAGONS, SQUARES, ANGLES *and* SPECIAL SHAPES
Monel, Nickel and Inconel

"R" MONEL MACHINING QUALITY

*

COLD DRAWN WIRE
Monel and Nickel

*

COLD DRAWN SEAMLESS TUBING
Monel, Nickel and Inconel

*

WELDED MONEL TUBING

*

WELDING WIRE *and* FLUXES
Monel, Nickel and Inconel

*

ACCESSORIES
Fastenings, Monel and Nickel

*

CASTINGS
Monel, Nickel and Inconel

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"H" AND "S" MONEL CASTINGS

*

WIRE AND FILTER CLOTH
Monel and Nickel

*

"K" MONEL
Can be heat treated for higher mechanical properties — available in most forms

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